

CLAIMS

What is claimed is:

1) A system for monitoring and controlling quality of service and availability of a discrete event system composed of a computer network and its traffic load, said system comprising :

an intermediate device, said intermediate device including memory for storing a program that monitors the condition and availability of components in the computer network, including links and intermediate nodes, and that also monitors the traffic load of the computer network, that includes said program determining whether imbalances exist between traffic load and bandwidth in said network and which determines how to optimally correct said imbalances either by buying and selling of short term bandwidth or by actuation of said network's topology and resources, including links and/or intermediate node capacities, and downloading said bandwidth actuations to bandwidth managers in the computer communications network; and

a set of traffic actuation devices, said devices including intermediate nodes responsible for relaying traffic between links in the computer communications network, including cache content managers responsible for deciding where to locate content caches in the computer communications network and when to have each content cache active, including bandwidth managers responsible for adding or deleting bandwidth in the computer communications network either temporarily or permanently.

2) A system as described in Claim 1 wherein said intermediate device is a computer system.

3) A system as described in Claim 1 wherein said intermediate device is an automatic network management computer.

4) A system as described in Claim 1 wherein said intermediate device collects bandwidth and traffic statistics from intermediate nodes in the computer communications network that is being managed.

5) A system as described in Claim 1 wherein said intermediate device determines the times and locations of bandwidth imbalances in the computer communications network and their persistence.

6) A system as described in Claim 1 wherein said intermediate device actuates the traffic intensity by downloading the times and locations of the bandwidth imbalances found in Claim 5 to a bandwidth manager in the computer communications network.

7) An intermediate device for monitoring and controlling quality of service and availability of a discrete event system composed of a computer communications network and its traffic load, said intermediate device comprising :

an intermediate device, said intermediate device including memory for storing a program that monitors the condition and availability of components in the computer network, including links and intermediate nodes, and that also monitors the traffic load of the computer network, that includes said program determining whether imbalances exist between traffic load and bandwidth in said network and which determines how to optimally correct said imbalances either by buying and selling of short term bandwidth or by actuation of said network's topology and resources, including links and/or intermediate node capacities, and downloading said bandwidth actuations to bandwidth managers in the computer communications network;

8) A system as described in Claim 7 wherein said intermediate device is a computer system.

9) A system as described in Claim 7 wherein said intermediate device is an automatic network management computer.

10) A system as described in Claim 7 wherein said monitoring and controlling causes the quality of service and availability variables for the discrete event system to improve.

11) A method for monitoring and controlling the quality of service and availability variables for a discrete event system composed of a computer communications network and its traffic load, said method comprising the steps of:

(a) Establish an objective to be attained for example a range of acceptable response times, server utilizations and traffic intensities, or other parameters; and

- (b) Monitor the arrival of traffic and its servicing by the network's links; and
  - (c) Based on these measurements and/or estimates, decide the intervention (if any) to optimize the network's performance; and
  - (d) Effect the change using the available management actuators - workload and/or bandwidth.
- 12) A method as described in Claim 11 wherein step (a) comprises establishing an objective to be attained for example a range of acceptable response times, server utilizations and traffic intensities, or other parameters and storing them in memory of a computer system.
- 13) A method as described in Claim 11 wherein step (a) comprises establishing an objective to be attained for example a range of acceptable response times, server utilizations and traffic intensities, or other parameters and storing them in memory of an automatic network management computer.
- 14) A method as described in Claim 11 wherein step (b) comprises monitoring the arrival of traffic and its servicing by the network's links and storing them in memory of a computer system.
- 15) A method as described in Claim 11 wherein step (b) comprises monitoring the arrival of traffic and its servicing by the network's links and storing them in memory of an automatic network management computer.
- 16) A method as described in Claim 11 wherein step (c) comprises deciding the intervention (if any) to optimize the network's performance and storing this in memory of a computer system.
- 17) A method as described in Claim 11 wherein step (c) comprises deciding the intervention (if any) to optimize the network's performance and storing this in memory of an automatic network management computer.
- 18) A method as described in Claim 11 wherein step (d) comprises effecting the change using the available management actuators - workload and/or bandwidth, and storing these changes in memory of a computer system.

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- 19) A method as described in Claim 11 wherein step (d) comprises effecting the change using the available management actuators - workload and/or bandwidth, and storing these changes in memory of an automatic network management computer.
- 20) In a computer system having a processor coupled to a bus, a computer readable medium coupled to said bus and having stored therein a computer program that when executed by said processor causes said computer system to implement a method for managing quality of service and availability in a computer communications network, said method comprising the steps of:
- (a) Establish an objective to be attained for example a range of acceptable response times, server utilizations and traffic intensities, or other..
  - (b) Monitor the arrival of traffic and its servicing by the network's links; and
  - (c) Based on these measurements and/or estimates, decide the intervention (if any) to optimize the network's performance; and
  - (d) Effect the change using the available management actuators - workload and/or bandwidth.
- 21) A computer readable medium as described above in Claim 20 wherein step (a) of said computer implemented method stored on said computer readable medium comprises establishing an objective to be attained for example a range of acceptable response times, server utilizations and traffic intensities, or other parameters and storing them in memory of a computer system.
- 22) A computer readable medium as described above in Claim 20 wherein step (a) of said computer implemented method stored on said computer readable medium comprises establishing an objective to be attained for example a range of acceptable response times, server utilizations and traffic intensities, or other parameters and storing them in memory of an automatic network management computer.
- 23) A computer readable medium as described above in Claim 20 wherein step (b) of said computer implemented method stored on said computer readable medium comprises monitoring the

arrival of traffic and its servicing by the network's links and storing them in memory of a computer system.

24) A computer readable medium as described above in Claim 20 wherein step (b) of said computer implemented method stored on said computer readable medium comprises monitoring the arrival of traffic and its servicing by the network's links and storing them in memory of an automatic network management computer.

25) A computer readable medium as described above in Claim 20 wherein step (c) of said computer implemented method stored on said computer readable medium comprises deciding the intervention (if any) to optimize the network's performance and storing this in memory of a computer system.

26) A computer readable medium as described above in Claim 20 wherein step (c) of said computer implemented method stored on said computer readable medium comprises deciding the intervention (if any) to optimize the network's performance and storing this in memory of an automatic network management computer.

27) A computer readable medium as described above in Claim 20 wherein step (d) of said computer implemented method stored on said computer readable medium comprises effecting the change using the available management actuators - workload and/or bandwidth, and storing these changes in memory of a computer system.

28) A computer readable medium as described above in Claim 20 wherein step (d) of said computer implemented method stored on said computer readable medium comprises effecting the change using the available management actuators - workload and/or bandwidth, and storing these changes in memory of an automatic network management computer.

29) A system for monitoring and controlling quality of service and availability in a communications comprising,

a processor including memory for storing an automatic network management program,

said processor configured to sample the bandwidth of network components and level of traffic and processing said size measurements to produce estimates of any imbalances between bandwidth and traffic.

    said processor being further configured to used said imbalances to control the performance of the network.

30) A system as in Claim 29 in which said processor is configured to provide bandwidth and traffic state information to capacity planning tools that seek to adjust traffic and bandwidth.

31) A system as in Claim 29 in which said processor is additionally configured to determine when certain links and/or intermediate nodes of the network have surplus bandwidth or a bandwidth deficit and the level of persistence of such bandwidth imbalances and when such imbalances should be actuated using either a bandwidth trading tool which will remedy or purchase bandwidth to actuate bandwidth deficits and/or make available surplus capacity for resale to third party traffic, or when such imbalances should be actuated by actuating the network's topology and/or bandwidth.